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# Development of soft wearable pneumatic actuators for variable-stiffness rehabilitative hand splints

PhD program in Industrial  
Engineering



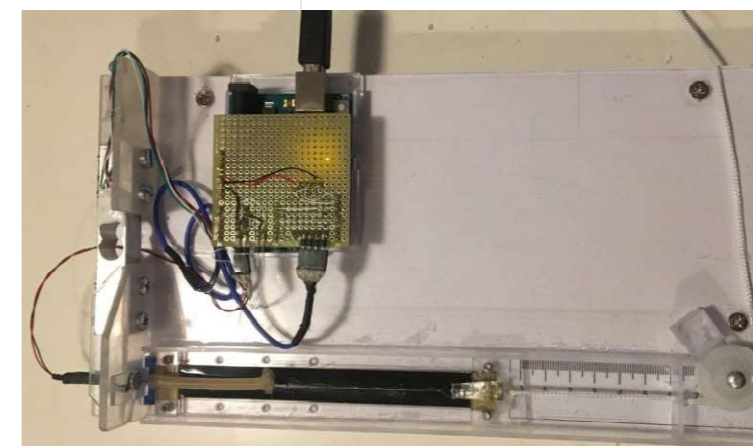
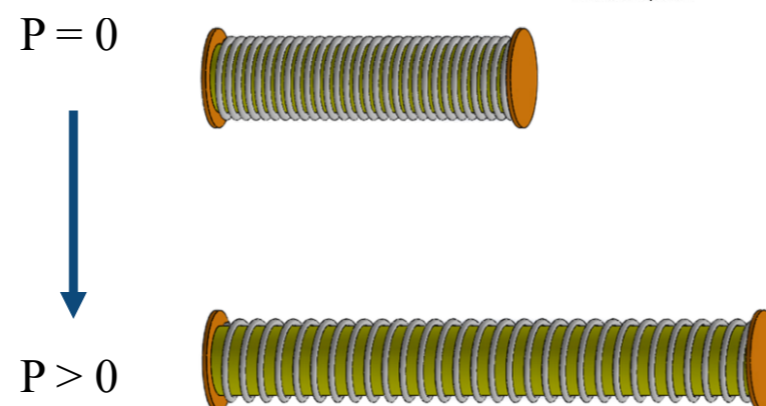
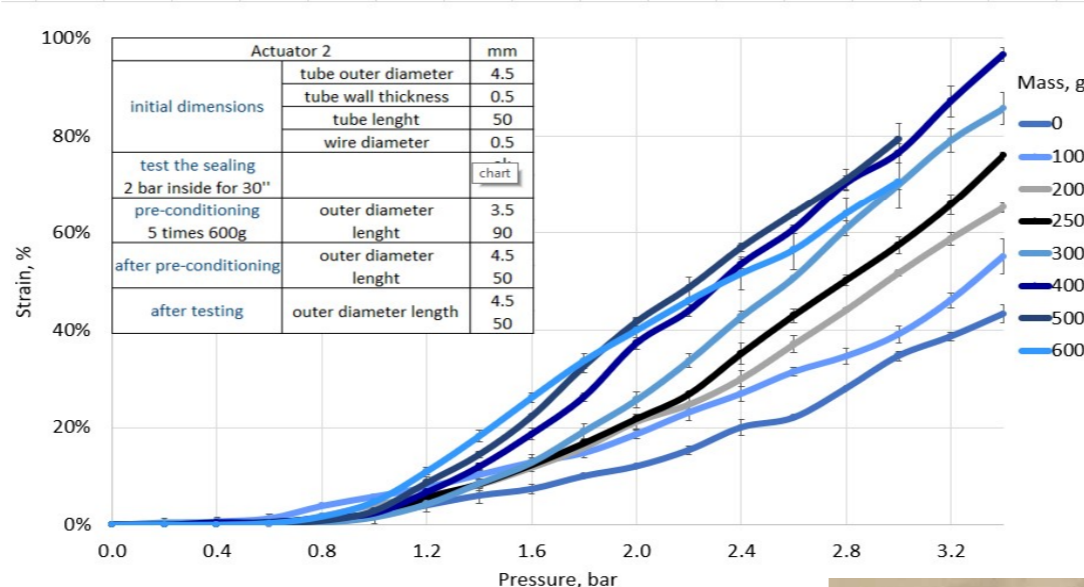
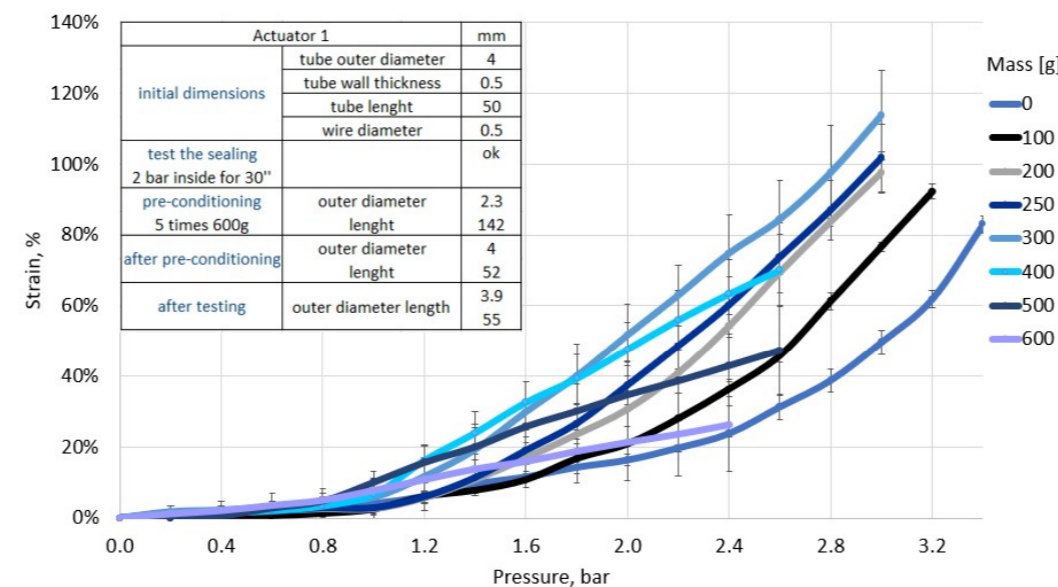
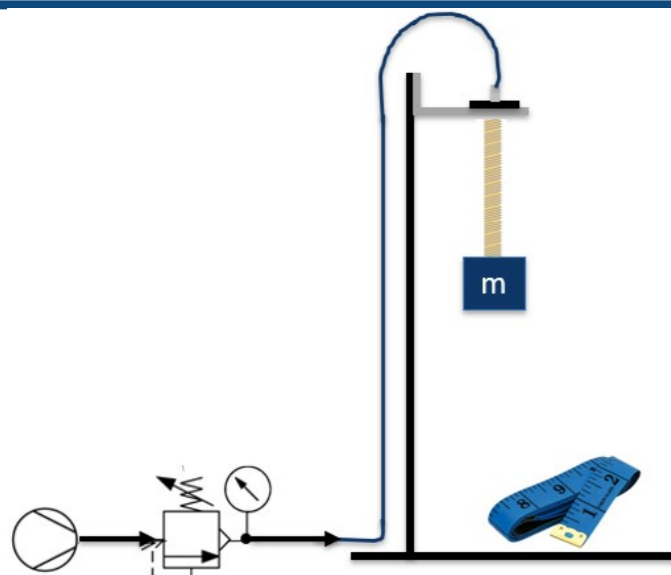
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## Introduction

Developing new types of rehabilitation systems requires new kinds of wearable soft actuators. As an example, so-called dynamic hand splints are used to perform rehabilitation of the hand, by applying forces that oppose voluntary movements of fingers. The devices are linear elongating actuators based on the so-called inverse McKibben configuration.

## Materials and methods

This system consists of wearable structures equipped with springs or elastic bands, which exert passive resistance to voluntary movements. Actuators consist of latex tubes (various dimensions), nylon fiber (0.5mm), PP (polypropylene, 0.5mm) which acts as sealant all parts are connected with adhesive Loctite 495. Nylon fiber restricts radial expansion of the actuator and enables just linear elongation.



## Results

Actuators are actuated by pressure up to 3 bar. Pressure causes linear elongation of actuators. Samples were loaded with mass up to 600g. The aim of the tests was to get insight into materials' reactions under different parameters of pressure and mass..

The graph illustrates percentage of strain with increased pressure and influence of outside load. Error bars illustrate standard deviation calculated from three tests. With higher loads bigger pressures are not recommended because of a possible risk of actuator malfunction.

## Conclusions

Research on soft wearable pneumatic actuators is still ongoing. Actuators are easily manufactured with off-the-shelf parts and affordable. The aim is to combine actuators with dielectric elastomer-based capacitive strain sensors, so as to continuously monitor their deformation and implement suitable control strategies.

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